

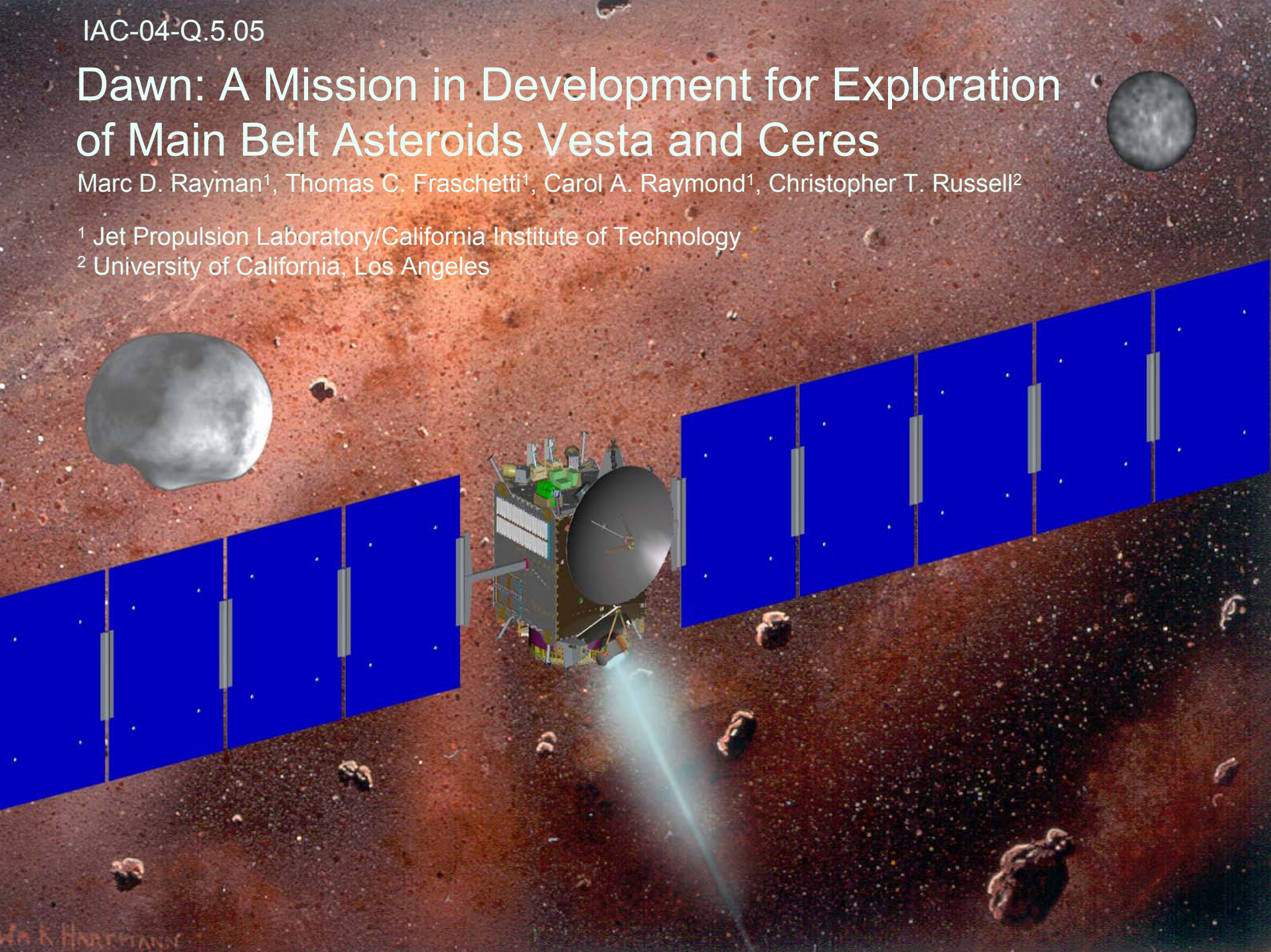
IAC-04-Q.5.05

# Dawn: A Mission in Development for Exploration of Main Belt Asteroids Vesta and Ceres

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# Project Highlights



- Dawn is the 9th project in NASA's Discovery Program.
- Objective is to examine the geophysical properties of 1 Ceres and 4 Vesta.
  - Dawn will be the first mission to rendezvous with a main belt asteroid and the first mission to orbit two extraterrestrial (and nonsolar) bodies.
- Selected major responsibilities:
  - University of California, Los Angeles **UCLA**
    - Principal investigator
  - JPL **JPL**
    - Project and systems management, delivery of some portions of spacecraft, project systems engineering, safety and mission assurance, mission operations
  - Orbital Sciences Corporation **Orbital**
    - Spacecraft development, integration, and test

Dawn

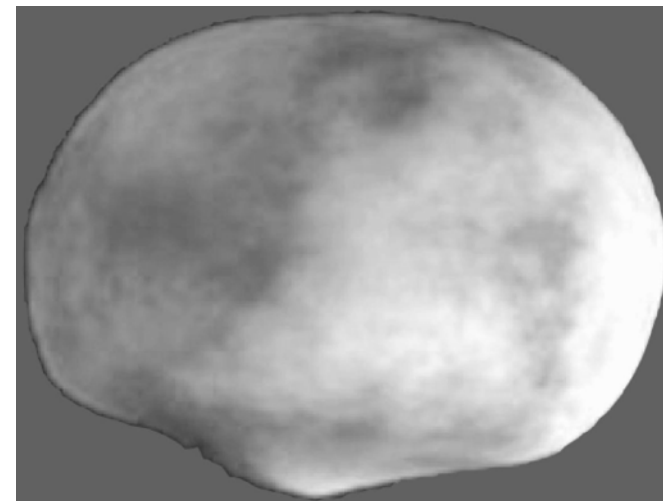




# Science Motivation



- By comparing Vesta and Ceres, Dawn will yield insights into conditions and processes acting at the formation of the solar system.
  - Although they are at similar distances from the Sun, Vesta was melted and is dry, while Ceres did not melt and retained water.
- Vesta and Ceres are unlike any asteroids that have been visited by spacecraft.
  - They are the 2 most massive asteroids.
  - Vesta is believed to be the source of the HED meteorites.



Smoothed HST image of Vesta



Thin section of HED meteorite

Dawn



# Ceres and Vesta Size in Context **JPL**

Mathilde



Vesta



Ceres



Pluto

California  
(smog not shown)

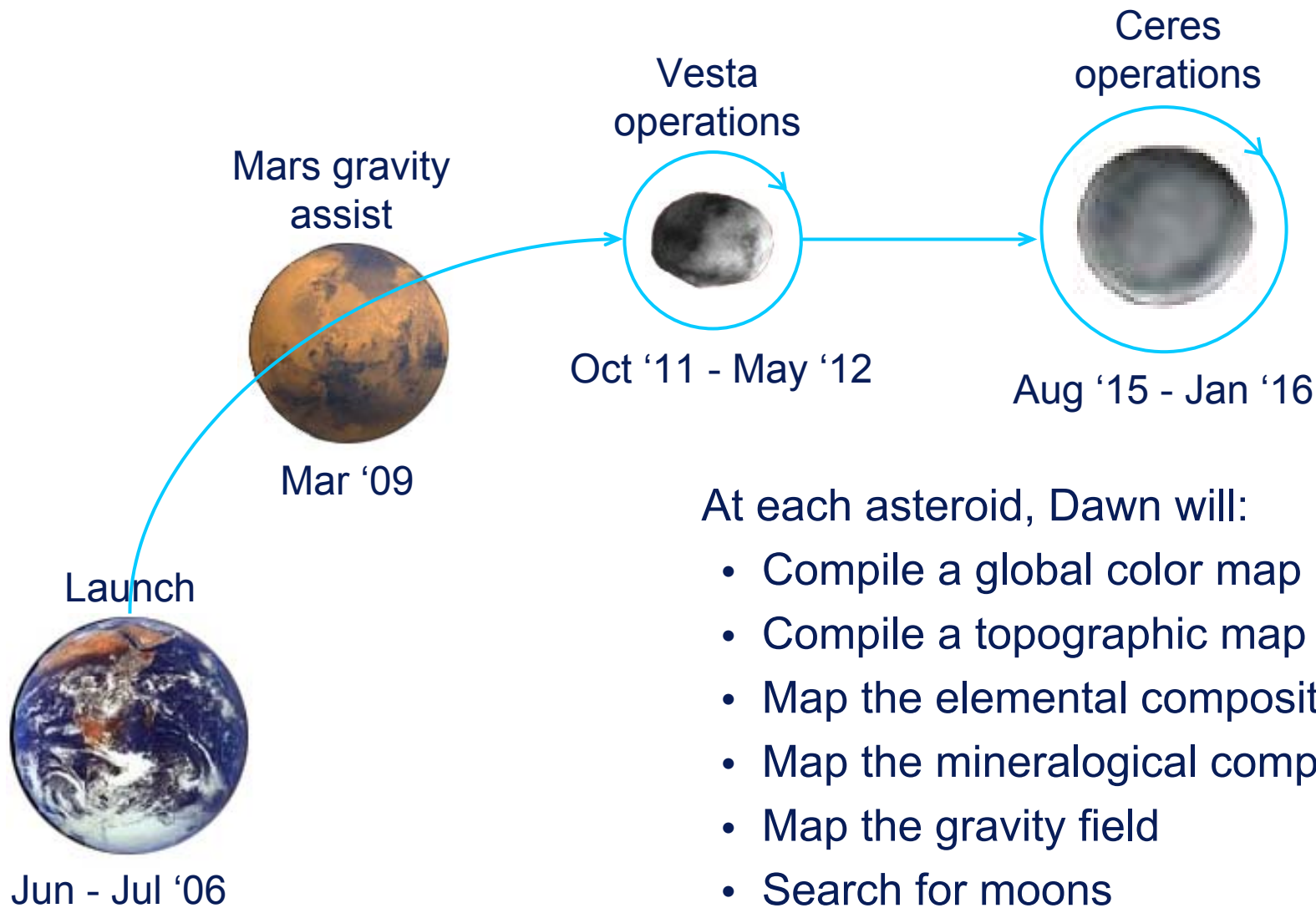


Earth's moon

Dawn



# Mission Itinerary



At each asteroid, Dawn will:

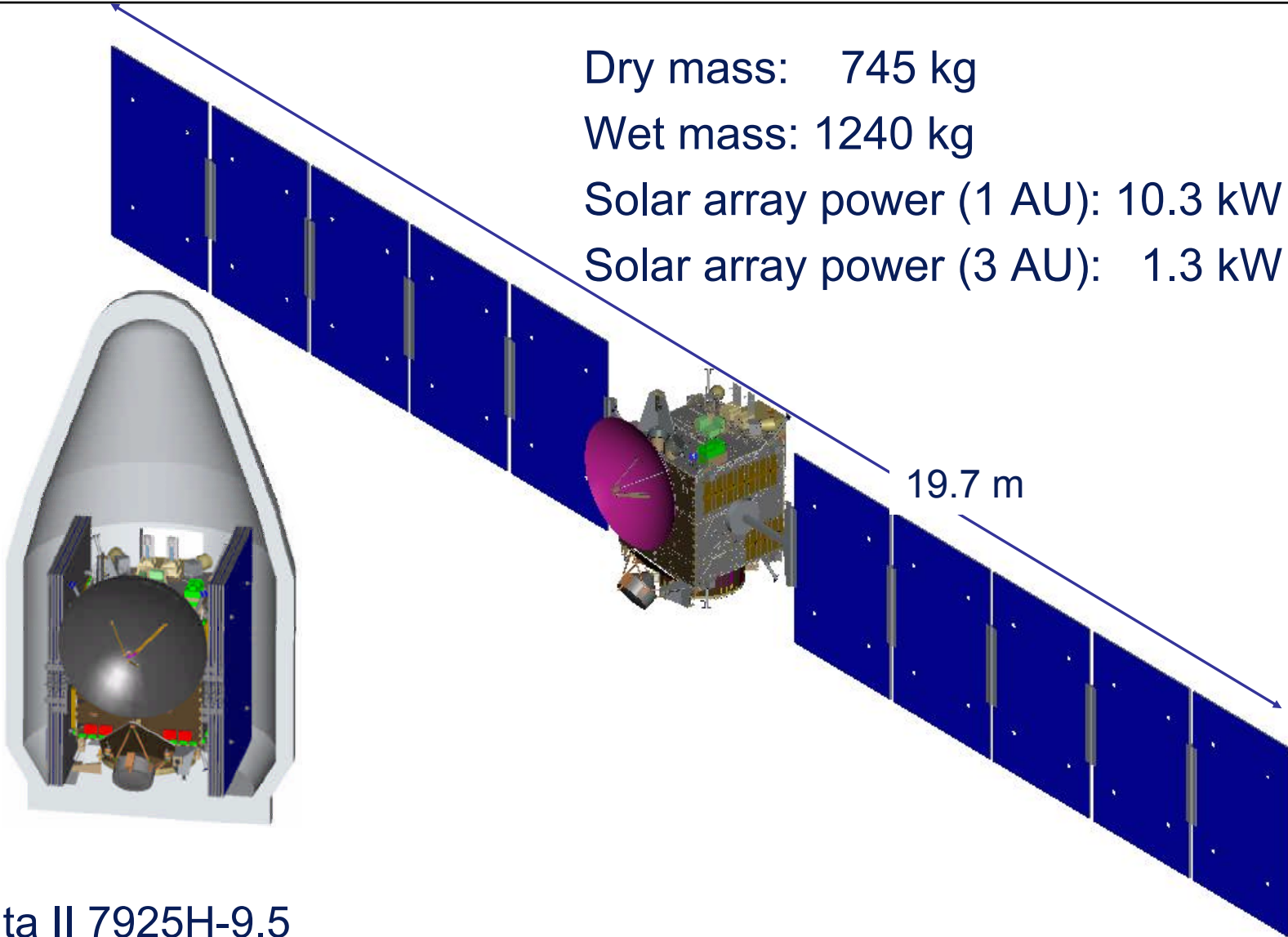
- Compile a global color map
- Compile a topographic map
- Map the elemental composition
- Map the mineralogical composition
- Map the gravity field
- Search for moons



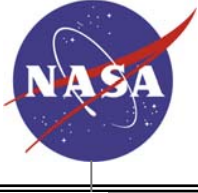
# Spacecraft Overview



Delta II 7925H-9.5





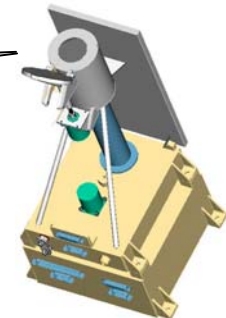
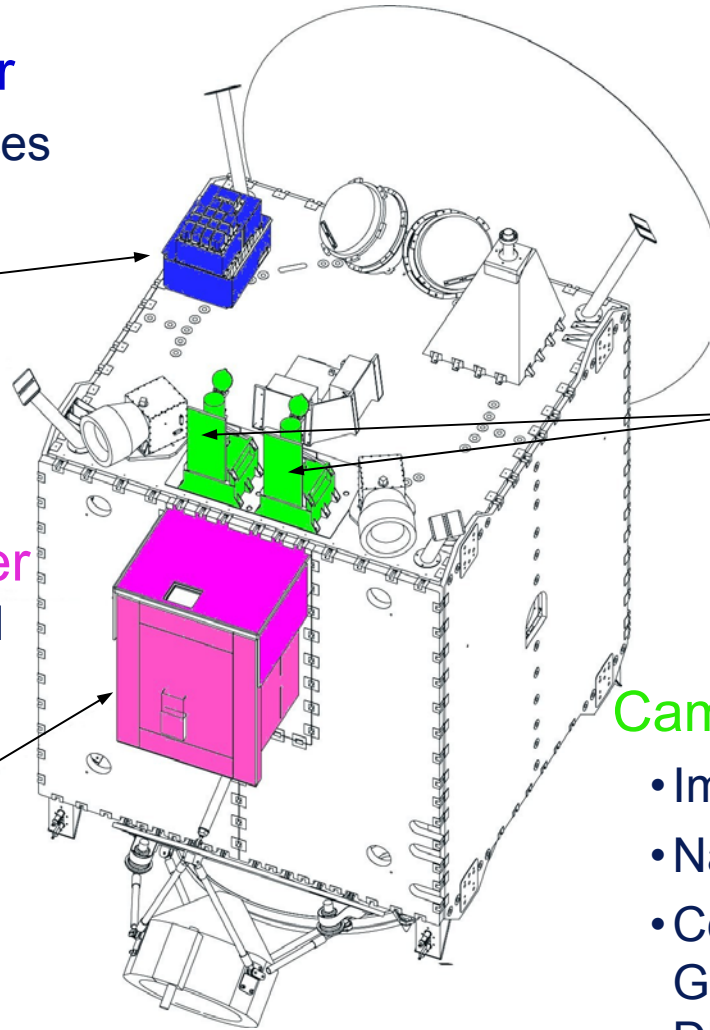
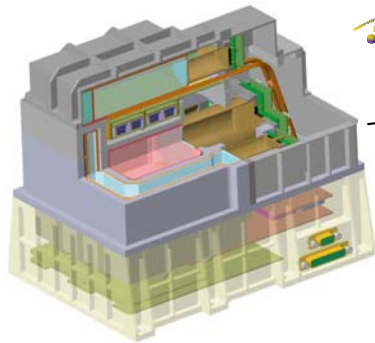


# Payload



## $\gamma$ ray and neutron spectrometer

- Mapping of elemental abundances



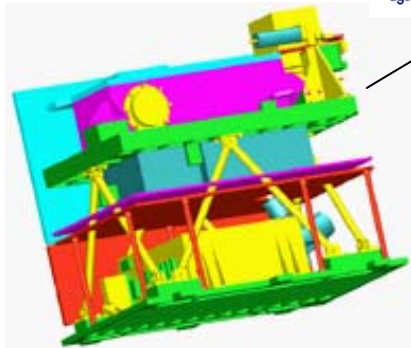
## Cameras (2)

- Imaging science
- Navigation
- Contributed by Germany's MPS & DLR



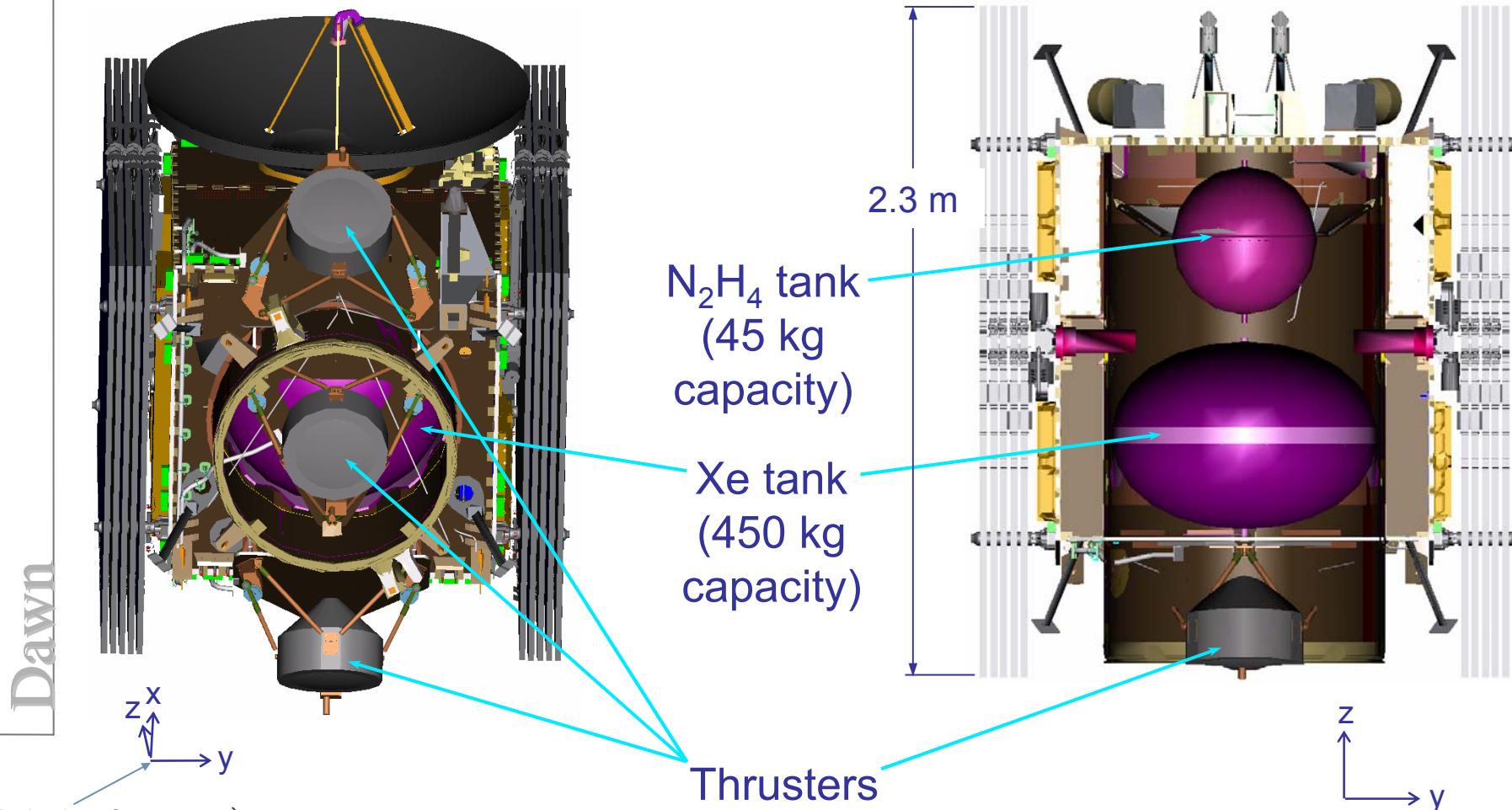
## Visible/IR mapping spectrometer

- High resolution mineralogical and thermal emissivity mapping
- Contributed by Italy's ASI





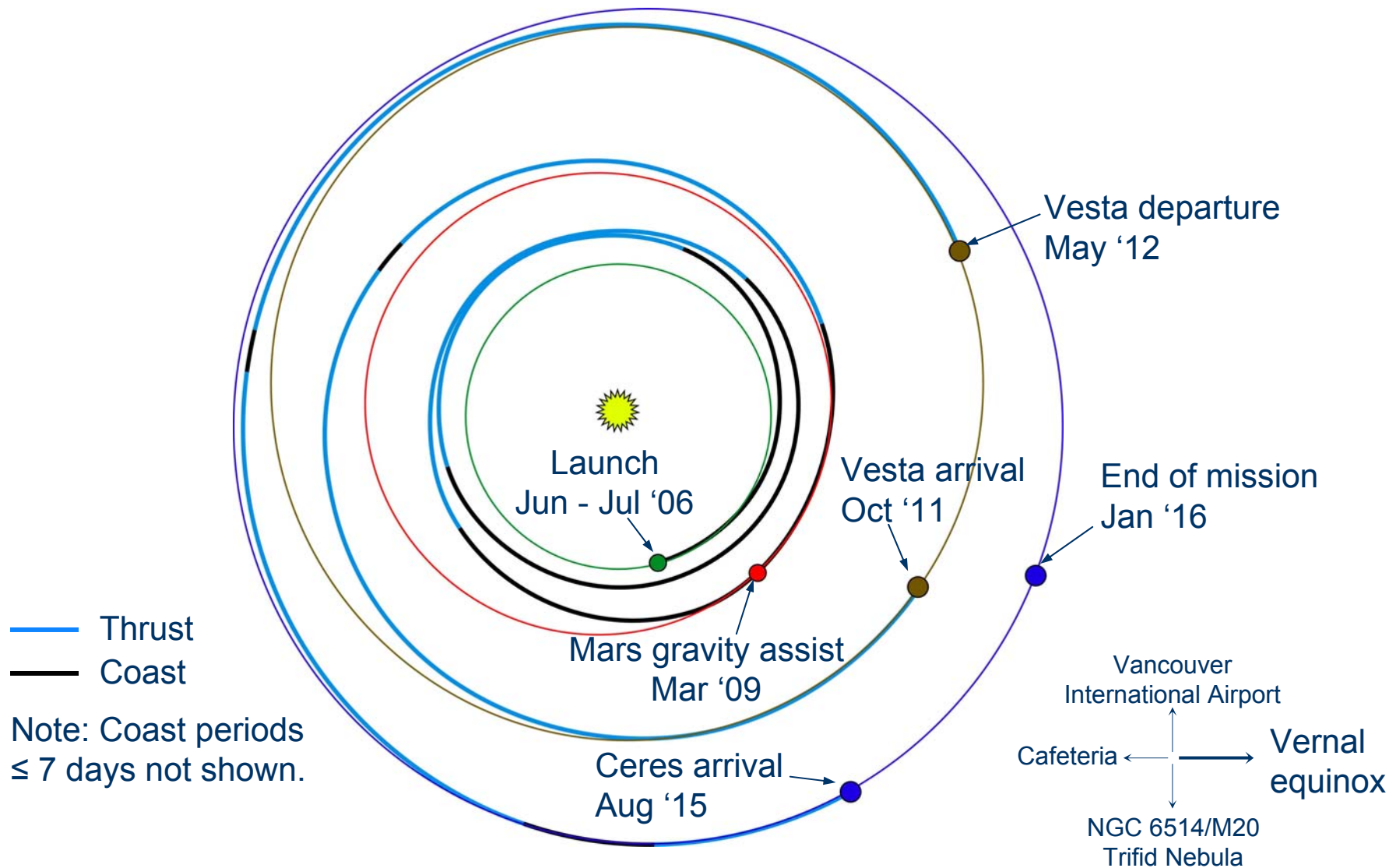
# Accommodation of IPS







# Interplanetary Trajectory

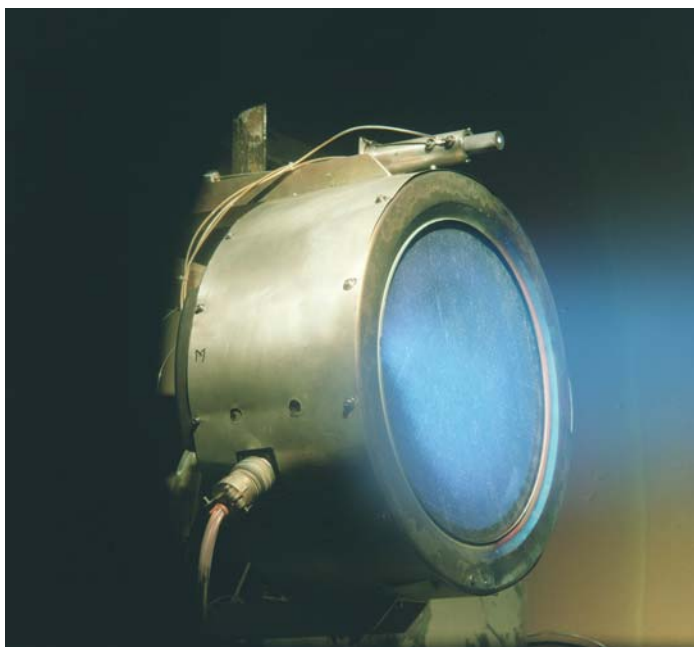




# Ion Propulsion Enables Dawn



- It is not possible to rendezvous with and orbit either one of Dawn's targets using a conventional propulsion system within the constraints of the Discovery Program.
- Without ion propulsion, a mission only to Vesta would require:



- A high energy version of the Atlas V or Delta IV, instead of the Delta II.
- A bipropellant system with ~ 2500 kg of propellants.

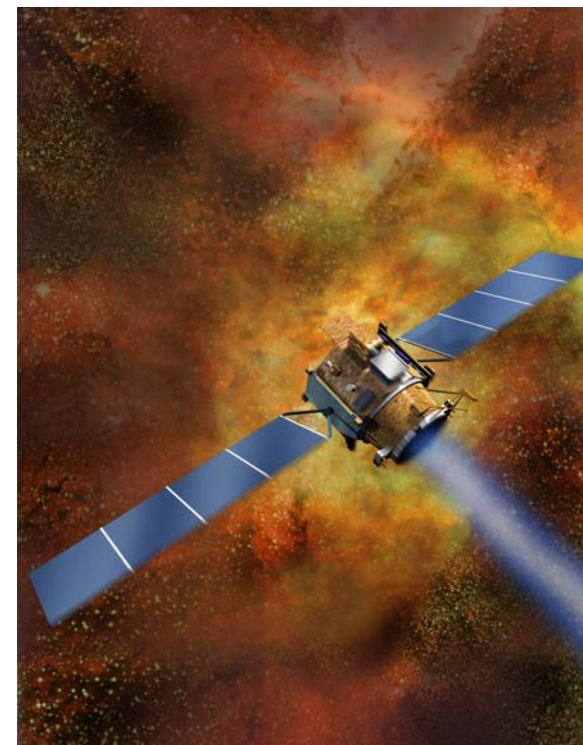
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# Use of Ion Propulsion

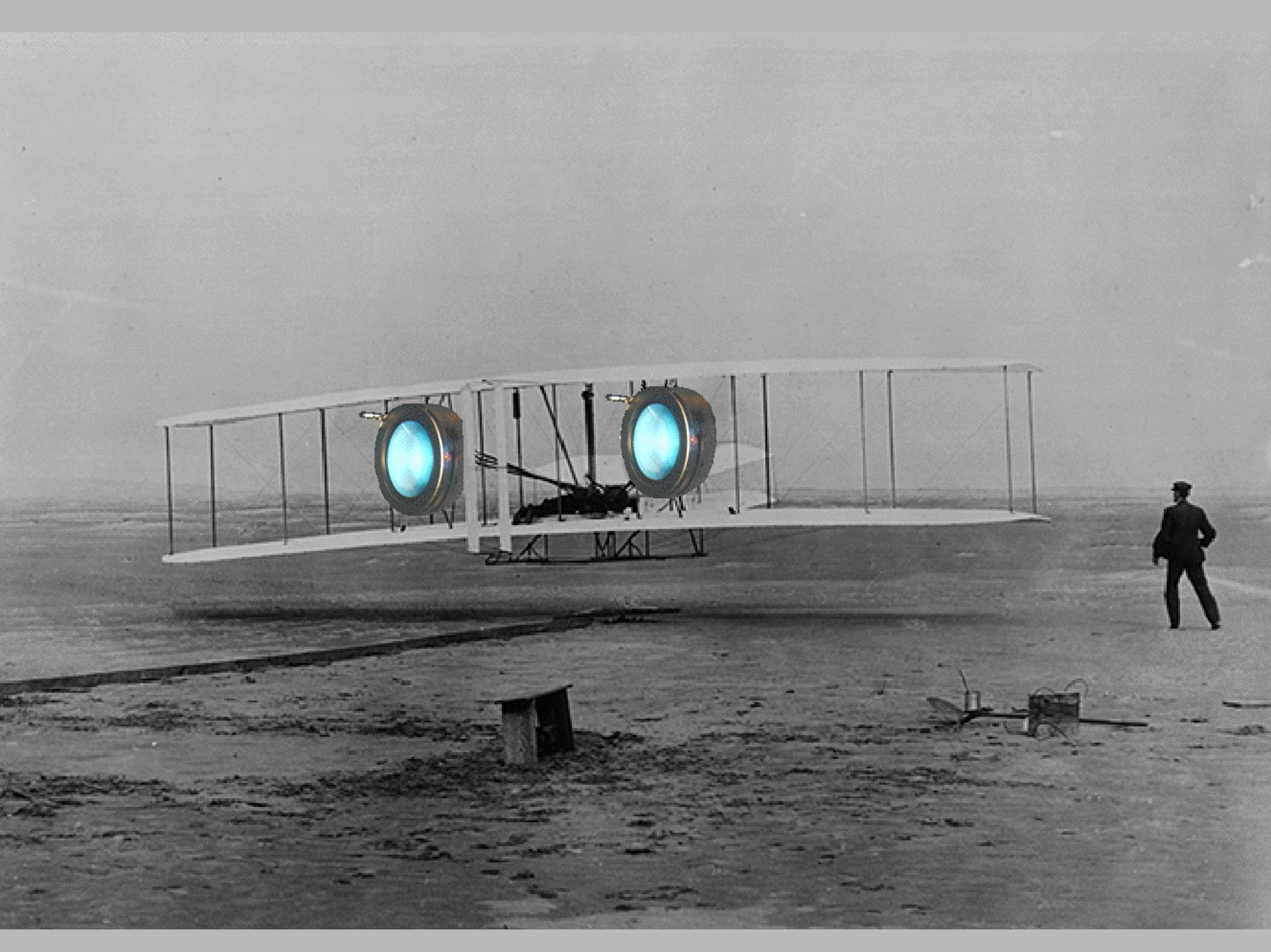


- Dawn's ion propulsion system (IPS) is inherited directly from the design proven on Deep Space 1.
- IPS  $\Delta v \approx 11 \text{ km/s} \approx \text{Delta 7925H } \Delta v$ 
  - This is  $2.5 \times$  the largest  $\Delta v$  ever attained with a spacecraft's propulsion system.
- The IPS on Dawn will be operated for  $\sim 55,000$  hours ( $> 6$  years).
  - This greatly exceeds the longest powered flight in the history of space exploration.



Dawn







# Future Pre-Launch Milestones **JPL**

- Beginning of spacecraft integration: Jan '05
- Transportation to Goddard Space Flight Center: Oct '05
- Transportation to Cape Canaveral: April '06
- Presentation of IAC-04-Q.5.06: ~ 2 minutes from now
- Lunch: noon

Dawn